WATER RESOURCES REVIEW for APRIL 1977

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

CANADA
DEPARTMENT OF THE ENVIRONMENT
WATER RESOURCES BRANCH

STREAMFLOW AND GROUND-WATER CONDITIONS

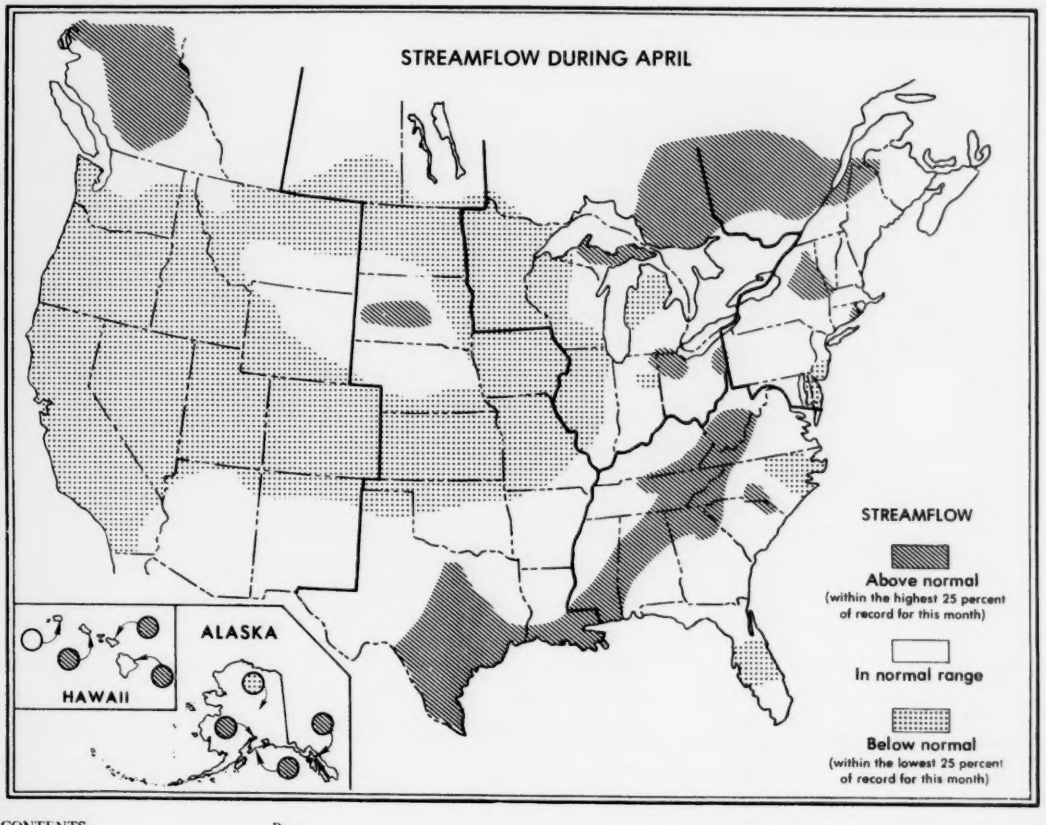
Severe drought conditions persist in most western States as well as in Kansas, Missouri, Iowa, Minnesota, and parts of Illinois, Wisconsin, and North and South Dakota. Seasonal water shortages were common in California with rationing plans in effect in most areas of the State. Reservoir storage remained below average in large areas of the West where snowpack continued below normal and was record low in many areas.

Monthly and daily mean flows were lowest of record in parts of California, Colorado, Idaho, and Utah, and highest of record in parts of Louisiana, Texas, Tennessee, Virginia, West Virginia, and Ontario.

Above-normal flows persisted in British Columbia, Ontario, Quebec, Alabama, Georgia, Maine, Mississippi, Tennessee, and Texas, and increased into that range in Louisiana, Michigan, and South Dakota.

Flooding occurred in Georgia, Kentucky, Louisiana, Mississippi, Ohio, Pennsylvania, Tennessee, Texas, Virginia, and West Virginia.

Ground-water levels continued to rise in the northern parts of the Northeast region but were variable or began to decline elsewhere. Levels rose locally in the northern part of the Southeast region, but generally declined and were below average in the southern part with several new lows. Trends varied in the Western Great Lakes region, but levels were generally below average. Levels rose in most of the Midcontinent region except in the major artesian aquifers of Louisiana; levels were generally below average except in eastern Iowa. A new low and two new highs were recorded in Texas. In the West, levels rose in Washington and Nevada, but generally declined elsewhere in the region; levels were generally below average. A new high for April occurred in Nevada, and new end-of-month lows were recorded in Nevada, Utah, New Mexico, and in Arizona, where two alltime lows also occurred.



CONTENTS:

NORTHEAST

[Atlantic Provinces and Quebec; Delaware, Maryland, New York, New Jersey, Pennsylvania, and the New England States]

Streamflow generally increased seasonally in the Atlantic Provinces and Quebec, and in Maine, New Hampshire, and New York, but generally decreased elsewhere in the region. Monthly mean flows remained in the above-normal range in parts of Connecticut, Maine, New York, and Quebec, increased into that range in central Maryland, and remained below the normal range in eastern Maryland and Delaware. Some lowland flooding occurred in Pennsylvania. Ground-water levels continued to rise in many of the northern parts of the region, but in most other areas levels fluctuated only slightly or began to fall.

High carryover flow from March, augmented by runoff from heavy rains throughout April, resulted in lowland flooding along some streams in Pennsylvania. Monthly mean discharges were near or slightly above median at all index stations in the State.

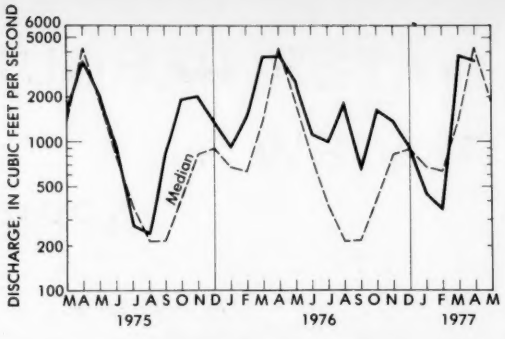
In eastern New York, where monthly mean flows in Hudson River at Hadley and Mohawk River at Cohoes were above the normal range in March, sharply increased flows occurred as a result of runoff from rains on April 24 and 25 and monthly mean discharges remained in the above-normal range. Similarly, in eastern Connecticut, where monthly mean flow in Salmon River near East Hampton was above the normal range in March, sharply increased runoff from rains during April contributed toward holding monthly mean discharge in the above-normal range.

Flows in St. John River below Fish River, at Fort Kent in northern Maine, and in Harricana River at Amos and St. Maurice River at Grand Mere, in adjacent Quebec, also remained above the normal range as a result of high carryover flows from March and seasonal increases in monthly mean discharges in April.

In nearby Vermont, where mean discharge of White River at West Hartford was above the normal range and nearly 3 times median in March, flow decreased contraseasonally and was below median in April. (See graph.) Elsewhere in central New England (Massachusetts, New Hampshire, and Rhode Island), monthly mean flows decreased in some streams and increased in others and were slightly above median.

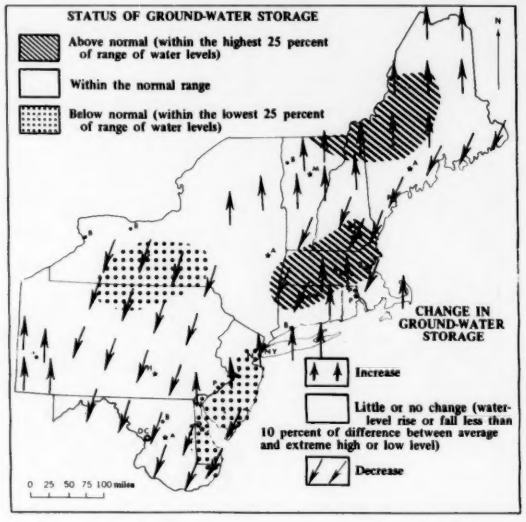
In the Atlantic Provinces, streamflow increased seasonally and was greater than median except in northern Nova Scotia, where monthly mean discharge in Northeast Margaree River at Margaree Valley decreased contraseasonally, from the record-high flow of March (8 times median), and was less than median but within the normal range.

In central Maryland, monthly mean flow in Seneca Creek at Dawsonville increased contraseasonally as a result of runoff from rains early in the month and was above the normal range for the first time since October 1976. In eastern Maryland and the adjacent area of Delaware, flow at the index station, Choptank River near Greensboro, Md., decreased seasonally and remained below the normal range for the 3d consecutive month. In the adjacent area of southern New Jersey, monthly mean discharge in Great Egg Harbor River at Folsom increased contraseasonally, but, partly as a result of low carryover flow from March, remained below the normal range where it has been for 5 consecutive months.



Monthly mean discharge of White River at West Hartford, Vt. (Drainage area, 690 sq mi; 1,787 sq km)

Ground-water levels continued to rise in northern New England and adjacent New York State and in a few smaller areas, including central Massachusetts, adjacent parts of Connecticut and Rhode Island, and on Long Island, N.Y. (See map.) Levels declined in southern Maine, New Hampshire, and Vermont, as well as in south-central New York, central Pennsylvania, and in



Map shows ground-water storage near end of April and change in ground-water storage from end of March to end of April.

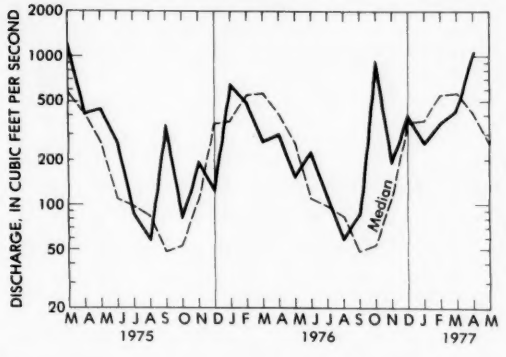
most of Maryland and Delaware. Levels near end of month were above average in northwestern Maine, northern New Hampshire, most of Massachusetts, and in northern Connecticut; were below average in south-central New York, north-central Pennsylvania, and in most of New Jersey and Delaware; and were generally in the normal range elsewhere in the region.

SOUTHEAST

[Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia]

Streamflow generally decreased seasonally except in parts of Georgia, North Carolina, Tennessee, Virginia, and West Virginia. Monthly mean flows decreased into the below-normal range in southeastern Florida and remained in that range in parts of eastern North Carolina. Flows in the above-normal range occurred in parts of each State in the region except Florida. Severe flooding occurred in Virginia, West Virginia, Kentucky, Tennessee, and Mississippi. Ground-water levels rose in parts of West Virginia, and in Kentucky, Virginia and North Carolina, but generally declined and were below average in the southern part of the region. New lows were noted in Tennessee, Mississippi, and Florida.

Runoff from rains of as much as 15 inches in 48 hours caused extreme flooding in southwestern Virginia and parts of adjacent States during the period April 4-7. The accompanying table and map show peak stage and discharge data and locations of selected measurement sites in the flood area. In addition to the peak stages and discharges, which were highest of record on many streams, some monthly and daily mean discharges also were greater than any previously observed during April. For example, on North Fork Holston River near Saltville (drainage area, 222 square miles), in southwestern Virginia, the monthly mean of 1,057 cfs, and the daily mean of 11,000 cfs on the 5th, were the highest observed in April during 58 years of record. (See graph.)



Monthly mean discharge of North Fork Holston River near Saltville, Va. (Drainage area, 222 sq mi; 575 sq km)

In eastern Tennessee, the monthly mean flow of 5,791 cfs, and the daily mean of 61,700 cfs on the 4th, on Emory River at Oakdale (drainage area, 764 square miles), were the highest observed in April since records began in 1927. In West Virginia, on Greenbrier River at Alderson (drainage area, 1,357 square miles), the daily mean of 47,000 cfs on the 5th, was highest for April in 82 years of record.

Similarly, in southwestern Mississippi, runoff from intense rains of almost 15 inches during the two-day period, April 21-22, caused severe flooding in a relatively small area along the Louisiana border. The peak discharge of about 29,000 cfs, April 22, on East Fork Amite River at Peoria was equal to the 100-year flood at that site. In southeastern Mississippi, monthly mean flow at Pascagoula River at Merrill decreased seasonally but remained in the above-normal range for the 2d consecutive month.

In central Alabama, streamflow remained in the above-normal range for the 2d consecutive month at Cahaba River at Centreville as a result of heavy rains and high carryover flow from March and was 2 times the median flow for April.

In Georgia, streamflow was generally above the normal range in north-central and northwestern parts of the State as a result of very heavy rains early in the month that produced local floods that ranged in frequency from 5 to 20 years. Monthly mean flow at the index station, Etowah River at Canton, increased contraseasonally, was nearly 2 times the median flow, and remained in the above-normal range for the 2d consecutive month.

In Florida, streamflow was generally in the normal range in the northern part of the State but decreased into the below-normal range in the central part of the State. For example, in central Florida, monthly mean flow at the index station, Peace River at Arcadia (drainage area, 1,367 square miles), decreased seasonally to 76 cfs, 16 percent of median, and below the normal range.

In South Carolina, streamflow was generally in the normal range as a result of below-normal precipitation. However, high carryover flow from March at Pee Dee River at Peedee caused monthly mean flow at that station to increase into the above-normal range.

In North Carolina, streamflow was below the normal range for the eastern Piedmont and Coastal Plain as a result of below-average precipitation and above the normal range in western sections of the State. For example, monthly mean flow at the index station, French Broad River at Asheville, in western North Carolina, increased contraseasonally and remained above the normal range for the 2d consecutive month. Some low overbank flooding occurred in central, northern, and

STAGES AND DISCHARGES FOR THE FLOODS OF APRIL 1977 AT SELECTED SITES IN KENTUCKY, TENNESSEE, VIRGINIA, AND WEST VIRGINIA

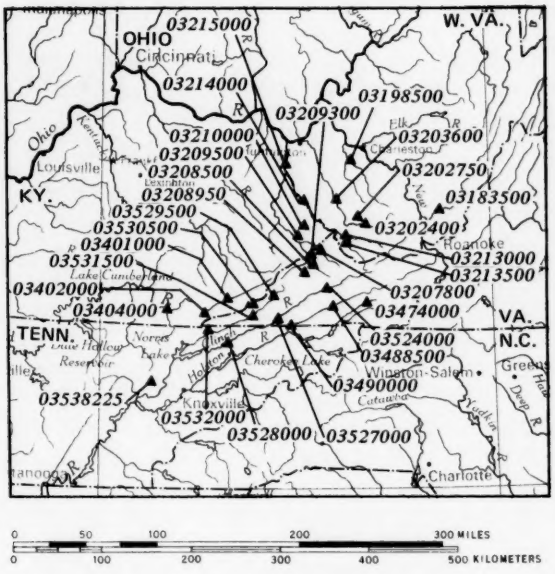
WRD station number	Stream and place of determination	Drainage area (square miles)	Period of known floods	Maximum flood previously known			Maximum during present flood				
				Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge		Recurrence interval (years)
									Cfs	Cfs per square mile	
KENTUCKY											
BIG SANDY RIVER BASIN											
03209300	Russell Fork at Elkhorn City.	554	1957–	Jan. 29, 1957	24.21	51,200	Apr. 4	24.84	54,200	98	>100
03209500	Levisa Fork at Pikeville.	1,237	1862, 1903, 1908–	Jan. 30, 1957	52.72	85,500	5	51.46	81,600	66	41
03210000	Johns Creek near Meta.	56.3	1938, 1941–	Mar. 12, 1963	17.38	7,380	4	18.52	5,050	90	9
03215000	Big Sandy River at Louisa.	3,892	1908, 1938–	Mar. 2, 1955	46.36	89,400	7	45.00	84,200	22	9
CUMBERLAND RIVER BASIN											
03401000	Cumberland River near Harlan.	374	1918, 1929, 1940–	Dec. 31, 1969	24.90	43,200	5	30.26	[a]64,500	172	>200
03402000	Yellow Creek near Middlesboro.	60.6	1929, 1939–	Nov. 28, 1973	20.24	9,980	4	23.35	11,700	193	85
03404000	Cumberland River at Williamsburg.	1,607	1929, 1946, 1950–	Jan. 31, 1957	33.78	49,700	7	35.03	46,600	30	25
TENNESSEE											
TENNESSEE RIVER BASIN											
03528000	Clinch River above Tazewell.	1,474	1862, 1918–	Feb. 1862	24	[b]66,000	Apr. 5	29.32	98,100	67	>100
03532000	Powell River near Arthur.	685	1826, 1867, 1905–	Mar. 1826	29.5	34,000	5	38.96	[a]61,000	89	>100
03538225	Poplar Creek near Oak Ridge.	82.5	1960–	Nov. 28, 1973	27.1	9,780	5	27.93	12,000	145	>50
VIRGINIA											
BIG SANDY RIVER BASIN											
03207800	Levisa Fork at Big Rock.	297	1957, 1967–	Jan. 29, 1957	23.0	(c)	Apr. 4	27.28	60,000	202	>100
03208500	Russell Fork at Haysi.	286	1926–	Jan. 29, 1957	23.17	46,600	4	28.24	57,000	199	100
03208950	Cranes Nest River near Clintwood.	66.5	1957, 1963–	Mar. 7, 1967	19.86	7,120	4	25.98	12,000	180	50
TENNESSEE RIVER BASIN											
03474000	Middle Fork Holston River at Sevenmile Ford.	132	1942–	Jan. 29, 1957	10.75	7,680	5	8.54	10,500	80	100
03488500	North Fork Holston River at Holston.	402	1952–	Jan. 29, 1957	16.50	24,300	5	18.70	[b]32,000	80	>100
03490000	North Fork Holston River near Gate City.	672	1862, 1932–	Feb. 1862	22.5	54,000	5	19.65	[b]42,000	62	100
03524000	Clinch River at Cleveland.	528	1920	Jan. 30, 1957	24.40	31,000	5	26.34	[b]36,000	68	>100
03527000	Clinch River at Speers Ferry.	1,126	1862, 1896–	Feb. 1862	33	(c)	5	34	56,000	50	100
03529500	Powell River at Big Stone Gap.	112	1945–	Jan. 7, 1946	9.8	16,500	4	16.50	[b]35,000	312	100
03530500	North Fork Powell River at Pennington Gap.	70	1945–	Mar. 12, 1963	13.65	13,100	4	16.14	[b]20,000	286	100
03531500	Powell River near Jonesville.	319	1931–	Mar. 12, 1963	33.36	31,100	5	38.16	[b]45,000	141	100

See footnotes at end of table.

STAGES AND DISCHARGES FOR THE FLOODS OF APRIL 1977 AT SELECTED SITES IN KENTUCKY, TENNESSEE, VIRGINIA, AND WEST VIRGINIA--Continued

WRD station number	Stream and place of determination	Drainage area (square miles)	Period of known floods	Maximum flood previously known			Maximum during present flood				
				Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge		Recurrence interval (years)
									Cfs	Cfs per square mile	
WEST VIRGINIA											
KANAWHA RIVER BASIN											
03183500	Greenbrier River at Alderson.	1,357	1895–	Mar. 14, 1918	22.0	77,500	Apr. 5	19.82	54,100	40	10
03198500	Big Coal River at Ashford.	393	1908–16, 1930–	Aug. 9, 1916	35.66	35,800	5	22.67	19,700	50	<10
GUYANDOTTE RIVER BASIN											
03202400	Guyandotte River near Baileysville	308	1968–	Jan. 11, 1974	17.31	18,600	5	26.89	[a]32,000	104	>100
03202750	Clear Fork at Clear Fork.	123	1974–	Mar. 24, 1975	14.58	4,200	5	18.64	[a]10,500	85	24
03203600	Guyandotte River at Logan.	836	1960–	Mar. 12, 1963	34.98	55,000	5	30.55	43,900	53	<10
BIG SANDY RIVER BASIN											
03213000	Tug Fork at Litwar.	502	1930–	Jan. 29, 1957	21.60	35,700	4 or 5	27.37	(c)	.....	.....
03213500	Panther Creek near Panther.	30.8	1946–	Mar. 7, 1967	10.71	4,600	4 or 5	12.10	6,600	214	>50
03214000	Tug Fork near Kermit	1,185	1934–	Mar. 13, 1963	45.65	69,600	5 or 6	52.91	(c)	.....	.....

[a]About.
[b]Estimated.
[c]Discharge not determined.



Location of stream-gaging stations in Kentucky, Tennesee, Virginia, and West Virginia, described in table on page 4.

western sections of the State on April 5 and 6 as a result of 2–3 inches of rainfall.

Ground-water levels in West Virginia rose in the west-northwestern third of the State and in the eastern part of the panhandle, but declined elsewhere; levels were generally below average, but a few scattered above-average levels were noted. In Kentucky, levels generally rose slightly and were above average in most parts of the State. In Virginia, levels rose but continued about 2 feet below average in northern Virginia and in the Piedmont; the level in the Matoaka Manor well near Petersburg rose slightly and was above average. In western Tennessee, the 7th consecutive new monthly low was noted, for the end of April, in the key well in the "500-foot sand" near Memphis. In North Carolina, levels rose and were above average in the mountains and Piedmont, but declined and were below average in the Coastal Plain. In Mississippi, levels generally declined. In the Jackson metropolitan area, declines of about ½ to 1 foot were observed in wells screened in the Sparta Sand, about the same as last month. Along the Gulf Coast, record lows were established in some of the wells screened in both the Pascagoula and Graham Ferry Formations. The artesian pressure in the index well in Montgomery, in central Alabama, declined nearly 3 feet but was only slightly below average; the artesian level in the Centreville well declined nearly a foot but was a foot above average at month's end. In Georgia, levels in and near the center of pumping in the Savannah area ranged from 2 to 5 feet lower than last month and from 2 to 5

feet lower than last year. In the outlying area, levels declined 1 foot lower than last month and 2 feet lower than last year. Levels in Bryan and Liberty Counties were about the same as last month and 1.3 feet lower than last year. In the Brunswick area farther south, levels near the center of pumping were from 4 to 7 feet lower than last month and up to 2 feet lower than last year; the increased drawdown from last month was caused by resumption of normal pumping after a brief shutdown of industrial wells. Farther south, in the outlying areas of Brunswick and Glynn County, levels were slightly higher than last year but up to 3 feet lower than last month. Levels declined in most parts of northern and central peninsular Florida; they ranged from 0.5 foot lower near Ocala, in central Florida, to 10.6 feet lower near Mulberry in west-central Polk County. End-of-month levels ranged from 1.7 feet below average at Ocala to 16 feet below average near Mulberry. Levels declined to a new low for April at Orlando. In southeastern Florida, levels ranged from about the same to nearly a foot lower than last month, and from 0.2 to 1.7 feet below average.

WESTERN GREAT LAKES REGION

[Ontario; Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin]

Streamflow increased seasonally in Wisconsin, decreased in Indiana, and was variable elsewhere in the region. Flows remained in the below-normal range in parts of Illinois, Minnesota, and Wisconsin, and decreased into that range in parts of Indiana and Michigan. Mean flows increased into the above-normal range in parts of Michigan, Ontario, and Ohio. Minor flooding occurred in northwestern Ohio. Ground-water levels declined and were below average in Minnesota, remained fairly steady but below average in Wisconsin, Indiana, and Ohio, and rose but remained below average in Michigan and Illinois.

In Minnesota, where monthly mean flows at all index stations were in the normal range in March, flows returned to the below-normal range in April. In Buffalo River near Dilworth (drainage area, 1,040 square miles), in western Minnesota, the monthly mean discharge of 73.8 cfs was lowest for the month since 1938, and only 14 percent of median. The lowest April monthly mean flow at that station, in record beginning in 1931, was 33.5 cfs in 1931. In the central part of the State, the monthly mean discharge of 361 cfs in Crow River at Rockford (drainage area, 2,520 square miles) was 22 percent of median, and lowest for April since 1961. In southwestern Minnesota, mean flow in Minnesota River near Jordan (drainage area, 16,200 square miles) was 1,873 cfs, 23 percent of median, below the normal range for the 12th time in the past 13 months, and lowest for the month since 1968. In Mississippi River at St. Paul, in eastern Minnesota (drainage area, 36,800 square miles) the mean flow of 7,120 cfs in April was 26 percent of median, in the below-normal range for the 11th time in the past 12 months, the lowest for April since 1959, and was the 10th lowest mean flow during April since records began in 1892.

In Wisconsin, monthly mean discharge increased seasonally at all index stations, but remained in the below-normal range in the Chippewa, Jump, and Wisconsin Rivers. In Chippewa River at Chippewa Falls (drainage area, 5,600 square miles) the mean discharge of 6,138 cfs was only 63 percent of median, and was in the below-normal range for the 12th consecutive month. Similarly, in Wisconsin River at Muscoda (drainage area, 10,300 square miles) the monthly mean flow of 7,783 cfs was only 51 percent of median, and was below the normal range for the 11th consecutive month. In northwestern Wisconsin, flow in Jump River at Sheldon increased sharply, but partly because of low carryover flow from March the monthly mean discharge in April again was below the normal range where it has been in 11 of the past 12 months.

In Illinois, monthly discharge increased slightly in Sangamon River at Monticello and in Rock River near Joslin, and decreased slightly in Pecatonica River at Freeport, but was in the below-normal range at each station. The monthly mean flow of 518 cfs at Freeport (drainage area, 1,326 square miles) was only about one-half of the April median and was in the below-normal range for the 11th consecutive month.

In Michigan, streamflow increased except in the northern part of the Lower Peninsula, where monthly mean discharge in Muskegon River at Evart decreased contraseasonally, was about one-half of the April median flow, was below the normal range for the 7th time in the past 8 months, and was the 6th lowest for April in 45 years of record. In the Upper Peninsula, mean flow in Sturgeon River near Sidnaw increased sharply and was in the above-normal range for the first time in the past 12 months. (See graph on page 8.)

In east-central Indiana, monthly mean flow in Mississinewa River at Marion decreased sharply into the below-normal range, where it has been during 5 of the past 6 months, and remained below median for the 9th consecutive month. Flows decreased seasonally at other index stations in the State but remained within the normal range.

In south-central Ontario, where monthly mean flow in Missinaibi River at Mattice (drainage area, 3,450 square

(Continued on page 8.)

SELECTED DATA FOR THE GREAT LAKES, GREAT SALT LAKE, AND OTHER HYDROLOGIC SITES

GREAT LAKES LEVELS

Water levels are expressed as elevations in feet above International Great Lakes Datum 1955

(Data furnished by National Ocean Survey, NOAA, via U.S. Army Corps of Engineers office in Detroit. To convert data to elevations above mean sea level datum of 1929, add the following values: Superior, 0.96; Michigan-Huron, 1.20; St. Clair, 1.24; Erie, 1.57; Ontario, 1.22.)

Lake	April 30, 1977	Monthly mean, April		April		
		1977	1976	Average 1900–75	Maximum (year)	Minimum (year)
Superior (Marquette, Mich.)	600.06	599.86	600.80	600.03	601.14 (1951)	598.23 (1926)
Michigan and Huron (Harbor Beach, Mich.)	578.70	578.58	580.06	577.99	580.32 (1973)	575.36 (1964)
St. Clair (St. Clair Shores, Mich.)	574.60	574.34	575.60	573.28	575.91 (1973)	571.09 (1901)
Erie (Cleveland, Ohio)	571.85	571.52	572.88	570.51	573.30 (1973)	568.20 (1934)
Ontario (Oswego, N.Y.)	245.23	245.07	246.78	245.01	247.69 (1973)	242.38 (1935)

GREAT SALT LAKE

Alltime high: 4,211.6 (1873). Alltime low: 4,191.35 (October 1963).	April 30, 1977	April 30, 1976	Reference period 1904–76		
			April average, 1904–76	April maximum (year)	April minimum (year)
Elevation in feet above mean sea level:	4,200.65	4,202.10	4,198.9	4,205.1 (1924)	4,192.75 (1963)

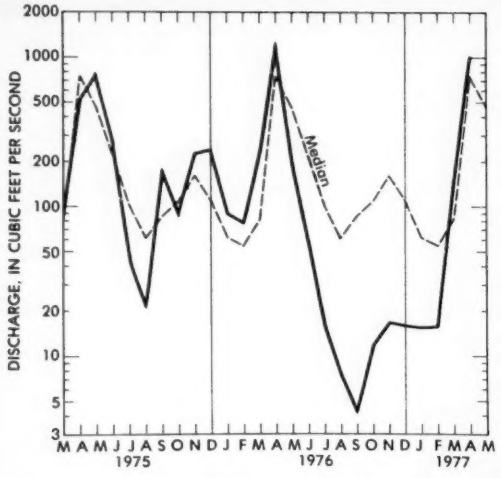
LAKE CHAMPLAIN, AT ROUSES POINT, N.Y.

Alltime high (1827–1975): 102.1 (1869). Alltime low (1939–1975): 92.17 (1941).	April 28, 1977	April 30, 1976	Reference period 1939–75		
			April average, 1939–75	April max. daily (year)	April min. daily (year)
Elevation in feet above mean sea level:	99.63	99.42	98.12	101.51 (1976)	94.11 (1965)

FLORIDA

Site	April 1977		March 1977	April 1976
	Discharge in cfs	Percent of normal	Discharge in cfs	Discharge in cfs
Silver Springs near Ocala (northern Florida)	780	102	810	622
Miami Canal at Miami (southeastern Florida)	84.4	270	110	3.65
Tamiami Canal outlets, 40-mile bend to Monroe	0	0	7.7	0

(Continued from page 6.)



Monthly mean discharge of Sturgeon River near Sidnaw, Mich. (Drainage area, 171 sq mi; 443 sq km)

miles) had been below the normal range for 11 consecutive months, flow increased sharply in late April and the monthly mean discharge of 14,700 cfs was highest for the month since records began in 1920. Elsewhere in the Province, mean flows were in the normal range.

In northwestern Ohio, rapid runoff from intense rains April 22–23 caused minor flooding along several streams. At the index station, Maumee River at Waterville, in northwestern Ohio, runoff from intense rains late in April retarded the normal rate of recession from the seasonal high flow of March and resulted in a monthly mean discharge about one and one-half times the April median and in the above-normal range. In the northeastern part of the State, flow in Little Beaver Creek near East Liverpool increased contraseasonally and the monthly mean discharge also was about 50 percent greater than median and above the normal range. In southern Ohio, flow in Scioto River at Higby decreased seasonally and remained below median but within the normal range.

Ground-water levels in shallow water-table wells in Minnesota declined and remained below average. The level in the key well at Camp Ripley, Morrison County, in central Minnesota, was the lowest for April in 24 years of record. In the Minneapolis-St. Paul area, artesian levels declined in wells tapping the Prairie du Chien–Jordan aquifer and declined slightly in the deeper Mt. Simon-Hinckley aquifer; both were below average. In Wisconsin, although levels in a few wells reached new lows for April, most levels were at or only slightly below normal. In Michigan, levels continued to rise but remained below average in most parts of the State. In northwestern Illinois, the level in the shallow index well in glacial drift at Princeton, in Bureau County, rose more than 1½ feet but was more than 3 feet below the average level for April. In Indiana, levels held steady during the month, and were slightly above the near-record lows of last month. Levels in central Ohio declined slightly, but rose in northeastern Ohio; they continued below average in both areas.

MIDCONTINENT

[Manitoba and Saskatchewan; Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas]

Streamflow increased seasonally in Manitoba, Kansas, North Dakota, Oklahoma, and Texas and was generally variable elsewhere in the region. Flows remained below the normal range in parts of each State in the northern part of region. Above-normal flows persisted in parts of Texas and increased into that range in parts of South Dakota and Louisiana. Flooding occurred in Louisiana and Texas where monthly and daily mean discharges were highest of record for April. Ground-water levels rose in most of the States in the region. However, levels in the major aquifers of Louisiana declined. Below-average levels were recorded in most areas except in eastern Iowa. A new low level and two new highs were recorded in Texas.

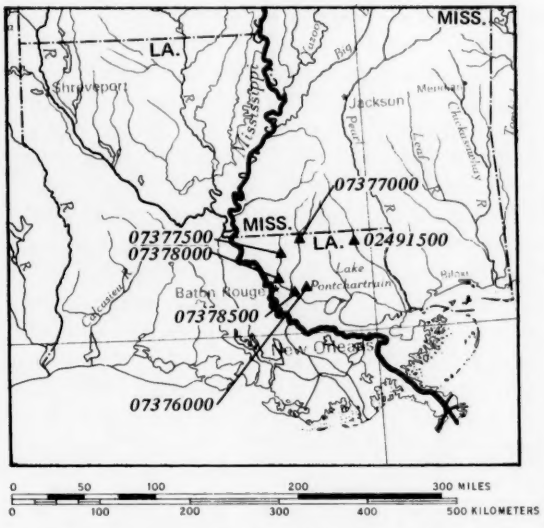
In southeastern Louisiana, record-breaking floods occurred along the Amite and Comite Rivers where damages estimated at $48 million occurred. Peak stages and discharges were highest of record at several gaging stations in the flood area; those data, and the locations of the gaging sites, are shown on the map, and in the table on page 9. In addition to the peak stages and discharges, some monthly and daily mean discharges were greater than any previously observed. For example, on Amite River near Denham Springs (drainage area, 1,280 square miles) the monthly mean flow of 11,470 cfs was highest for April and daily mean flow of 96,400 cfs on the 23d was highest for any day in 39 years of record. Daily flows at Pearl River at Bogalusa remained above flood stage for the 2d complete month.

In Texas, streamflow ranged from below normal in the Panhandle to above normal in the central and southeastern parts of the State. Intense rainfall during the middle of the month, especially in the San Antonio area, resulted in flooding on all major streams. At the index station, Guadalupe River at Spring Branch (drainage area, 1,315 square miles), the monthly mean discharge of 2,250 cfs and the daily mean flow of 27,100 cfs on the 16th were highest for April in 55 years of record.

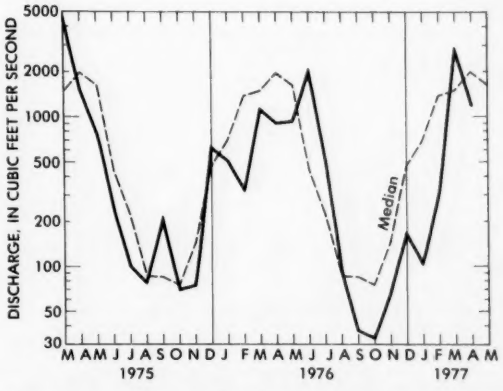
Provisional data; subject to revision

STAGES AND DISCHARGES FOR THE FLOODS OF APRIL 1977 AT SELECTED SITES IN LOUISIANA

WRD station number	Stream and place of determination	Drainage area (square miles)	Period of known floods	Maximum flood previously known			Maximum during present flood				
				Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge		Recurrence interval (years)
									Cfs	Cfs per square mile	
PEARL RIVER BASIN											
02491500	Bogue Chitto at Franklinton	985	1900, 1922–	Mar. 21, 1943	18.46	50,000	Apr. 22	17.05	50,800	52	10
MISSISSIPPI RIVER DELTA											
07376000	Tickfaw River near Holden	247	1940–	May 23, 1974	20.37	19,000	22	20.18	18,000	73	25
07377000	Amite River near Darlington	580	1949–	Mar. 25, 1973	20.19	62,100	22	21.76	72,300	125	22
07377500	Comite River near Olive Branch	145	1942–	Mar. 18, 1961	21.37	19,900	22	20.88	20,600	142	20
07378000	Comite River near Comite	284	1944–	Apr. 29, 1962	19.03	20,900	23	25.52	23,900	84	20
07378500	Amite River near Denham Springs	1,280	1938–	May 20, 1953	32.46	67,000	23	37.21	102,000	80	60



Locations of stream-gaging stations in Louisiana, described in table of peak stages and discharges.



Monthly mean discharge of Buffalo River near St. Joe, Ark. (Drainage area, 829 sq mi; 2,147 sq km)

Moderate flooding also occurred in the middle and lower Colorado River basins.

In northern Arkansas, where mean discharge of Buffalo River near St. Joe was above the normal range and nearly 2 times median in March, flow decreased contraseasonally and was only 60 percent of median in April but within the normal range. (See graph.)

In Oklahoma, streamflow was below the normal range in the northern half and near normal in the southern half of the State.

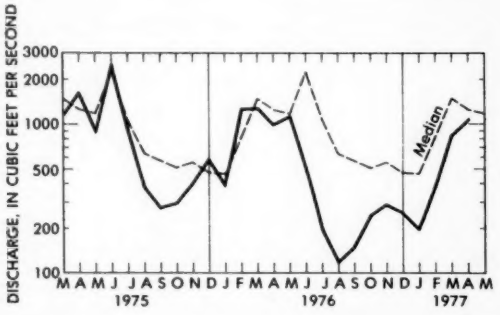
In northwestern Missouri, monthly mean discharge at Grand River near Gallatin decreased contraseasonally, was only 13 percent of median, and remained below the normal range for the 6th consecutive month. In south-central Missouri, streamflow decreased seasonally to the below-normal range at Gasconade River at Jerome. Mean flows at Jerome have been below the normal range in 10 out of the last 12 months. Small rises occurred on most streams in the State near midmonth.

In Kansas, streamflows increased seasonally as a result of substantial rain during the month with heavier amounts ranging up to 5 inches in the central part of the State. However, monthly mean discharges remained below the normal range for the 4th consecutive month

in the Little Blue River, for the 6th consecutive month in the Saline River, and for the 9th consecutive month in the Arkansas River.

In Iowa, streamflow remained below the normal range as scattered showers and thunderstorms that dropped 1 to 2 inches of rain over the State did not cause much increase in runoff. Monthly mean flows at the index stations on the Des Moines River at Fort Dodge and Cedar River at Cedar Rapids have been below the normal range for 13 and 10 consecutive months, respectively. The Corps of Engineers began storing water in Saylorville Lake (flood control reservoir on the Des Moines River upstream from Des Moines) on April 12. Outflow at monthend was 200 cfs with inflow approximately 500 cfs.

In northeastern Nebraska, where mean discharge had been below the normal range for 10 consecutive months at Elkhorn River at Waterloo, flow during April increased contraseasonally, was 86 percent of median and within the normal range. (See graph.) All



Monthly mean discharge of Elkhorn River at Waterloo, Nebr. (Drainage area, 6,800 sq mi; 17,900 sq km)

Republican River reservoirs had above-average gains in contents during the month but remained below the top of irrigation pool levels.

In eastern South Dakota, monthly mean discharge at the index station, Big Sioux River as measured at Akron, Iowa, decreased seasonally to less than 30 percent of median and was below the normal range. In the central part of the State, flow at Bad River near Fort Pierre increased contraseasonally to nearly 5 times the April median and was above the normal range as a result of above-average precipitation during the month.

In North Dakota, drought conditions continued in all but the southwest corner of the State. Rainfall at midmonth replenished soil moisture in the southeastern part of the State but resulted in little or no runoff. Monthly mean discharge of the Red River of the North at Grand Forks was the lowest for any April since 1938 and remained in the below-normal range for the 8th consecutive month.

In Manitoba, monthly mean discharge in Waterhen River below Waterhen Lake increased seasonally to nearly 5 times the mean flow in March but remained in the normal range at 113 percent of median. The level of Lake Winnipeg at Gimli averaged 711.66 feet above mean sea level, 1.46 feet below the long-term mean, and 0.14 foot lower than the average level last month.

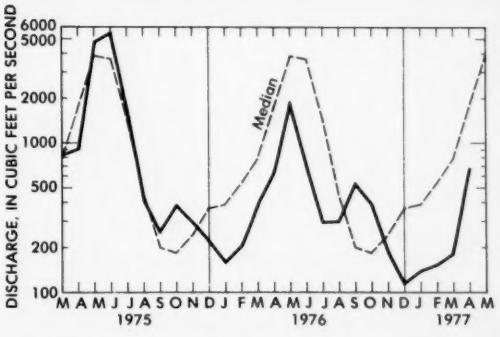
Ground-water levels in North Dakota rose slightly during the month, but continued below normal in the eastern half of the State. Levels generally rose slightly throughout Nebraska but most were below average at month's end. In areas of intensive development for municipal or irrigation supplies, levels were generally below those of last year. In the north-central part of the State, levels rose significantly because of recharge from snowmelt during the first week of April; levels in some localities were more than 2 feet higher than those of last month and of last year because there is little development of ground water in this part of the State. In Iowa, levels in shallow water-table wells generally rose throughout the State; those in the eastern part of the State were above average but continued below average in the western part. Levels in central and eastern Kansas rose somewhat but continued generally unchanged in the west, rising only slightly where pumping ceased because of adequate rainfall; levels generally continued below average. In the rice-growing area of east-central Arkansas, levels in the shallow aquifer rose slightly, but continued in the same range that has prevailed since 1964. The level in the deep aquifer——the Sparta Sand——rose 2¼ feet, reflecting the usual seasonal rise, but was 10⅔ feet below average, 4⅓ feet lower than last year, and at a new April low. In the industrial area of central and southern Arkansas, the level in the key well at Pine Bluff, also in the Sparta Sand, declined slightly, and was 12 feet below average and 2 feet lower than a year ago. At El Dorado, the level rose 1 foot and was 20 feet higher than in April 1966——the lowest April level on record. In Louisiana, levels declined in the major aquifers--the Chicot of the southwest, the Sparta Sand in the north, the 1,500-foot sand of Baton Rouge, the 700-foot sand of New Orleans, and the deep flowing-well aquifers in the southeast. Rising levels were recorded in wells in the terrace deposits and in the Miocene of the central area, and in the 400-, 600-, 2,000-, and 2,400-foot sands of Baton Rouge. In Texas, levels in key observation wells rose and were above average in San Antonio, rose but were below average at El Paso, declined but were above average at Austin, and declined at Houston. New April highs were recorded at Austin and San Antonio, and a new April low was recorded at El Paso despite a rise of nearly 1 1/4 feet.

WEST

[Alberta and British Columbia; Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming]

Streamflow was lowest of record for the month in parts of California, Colorado, Idaho, and Utah, and was only slightly greater than the lowest of record in parts of Arizona and Montana. Drought conditions continued to intensify in much of the region and were reported to be more severe in California than during the alltime record drought of 1924 in that State. Monthly mean flows remained in the below-normal range in parts of all States, but were in the above-normal range in British Columbia. Monthend snowpack generally remained only at the higher elevations and was far below normal. Monthend storage in major reservoirs in northern California, Idaho, and Washington also was below normal. Ground-water levels rose generally in Washington, and also in Nevada, where there was a new April high. Levels generally declined elsewhere in the region, with a few exceptions locally. Levels were generally below average; new lows for April occurred in Nevada and New Mexico, and in Arizona a new April low and two alltime lows were recorded.

In California, streamflow remained in the below-normal range at all index stations, and was lowest of record for the month at several stations. In the central part of the Sierra Nevada west slope, the monthly mean discharge of 208 cfs (13 percent of median), and the daily mean of 96 cfs on the 4th, in North Fork American River at North Fork Dam (drainage area, 342 square miles) were lowest for April in 36 years of record. In the south-central part of the State, the daily mean discharge of 201 cfs on the 3d in Kings River above North Fork, near Trimmer (drainage area, 952 square miles), was lowest for the month in 46 years of record and record low for the 2d consecutive month. Monthly mean flow increased seasonally but was only 39 percent of median, and was below the normal range for the 5th consecutive month. (See graph.) In the extreme north-coastal basin of Smith River, the monthly mean discharge of 1,412 cfs at the index station near Crescent City (drainage area, 609 square miles), and the daily mean of 780 cfs on the 30th, were lowest for the month in record that began in 1931. Monthly mean discharge has been lowest of record at this station in 4 of the past 5 months, and minimum daily mean discharge has been lowest of record in 3 of the past 4 months, indicating the prolonged severity of the lack of precipitation in this part of the State. In the northern part of the Great



Monthly mean discharge of Kings River above North Fork, near Trimmer, Calif. (Drainage area, 952 sq mi; 2,466 sq km)

Basin, in central California, the daily mean flow of 33 cfs on the 3d, in West Walker River below Little Walker River, near Coleville (drainage area, 180 square miles), was lowest for the month since records began in April 1938, and the 4th consecutive month in which the minimum daily discharge has been equal to or less than the previous minimum daily of record. Monthly mean flows have been below the normal range at this station in 13 of the past 15 months. In south-coastal California, monthly mean flow in Arroyo Seco near Pasadena decreased seasonally, was only 20 percent of the April median, and remained in the below-normal range for the 3d consecutive month. Efforts to conserve the available water supplies were reported to be increasing as more cities and towns impose water-rationing laws. Monthend storage in major reservoirs in northern California was 47 percent of that of a year ago. Snowmelt runoff from the mountainous areas occurred earlier than usual because of above-normal temperatures. Also, the snowpack was much lighter than normal and very little remained at monthend.

In southwestern Colorado, west of the Continental Divide, the monthly mean discharge of 250 cfs (36 percent of median) in Animas River at Durango (drainage area, 692 square miles), was lowest for April in 72 years of record, and the daily mean of 139 cfs on the 6th was only 1 cfs greater than the minimum daily mean of record (138 cfs in 1899). Monthly mean flows have been in the below-normal range at this station for 6 consecutive months. In the west-central part of the State, also west of the Divide, the monthly mean discharge of 329 cfs in Roaring Fork River at Glenwood Springs (drainage area, 1,451 square miles), was lowest for the month in 71 years of record, and was below the normal range for the 3d consecutive month. Also west of the Divide, the monthly mean discharge of 231 cfs in Yampa River at Steamboat Springs (drainage area, 604 square miles), was lowest for April in 70 years of record,

and in the below-normal range for the 6th consecutive month. The daily mean of 84 cfs on the 4th was only 5 cfs greater than the April minimum daily mean of record. East of the Divide, monthly mean flow in Arkansas River at Canon City was about one-half of median and remained below the normal range for the 5th consecutive month.

In southern Idaho, monthly mean flows in Weiser and Boise Rivers were lowest in 34 and 83 years of record, respectively, for the 2d consecutive month. Elsewhere in the State, monthly mean flows remained in the below-normal range in the Salmon, Snake, Kootenai, Clearwater, and Coeur d'Alene Rivers.

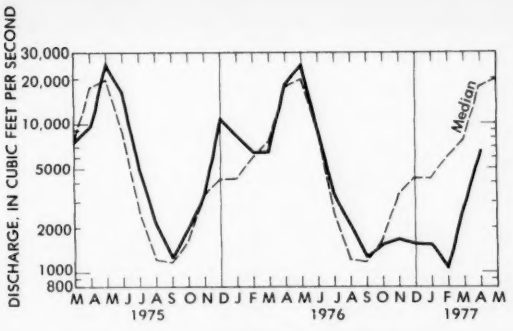
In eastern Utah, the monthly mean discharge of 1,525 cfs (24 percent of median), and the daily mean of 1,100 cfs on the 19th, in Colorado River near Cisco (drainage area, 24,100 square miles), were lowest for April in record that began in 1911. Monthly mean flows at this station have been decreasing contraseasonally since February, when seasonal increases should have begun, and have been below the normal range for 3 consecutive months. In the southwestern part of the State, the daily mean flow of 13 cfs on April 1, 3, and 4, in Beaver River near Beaver (drainage area, 90.7 square miles), was lowest for the month in record that began in March 1914. This was the 5th consecutive month in which a new record-low daily mean has occurred at this station, and the 14th consecutive month in which the monthly mean flow has been in the below-normal range. In northeastern Utah, the daily mean discharge of 33 cfs on April 2, in Weber River near Oakley (drainage area, 163 square miles), was lowest for April since records began in October 1904. Monthly mean discharges have been below the normal range at that station for the past 8 months. Also in the northeastern part of the State, monthly mean flow in Green River at Green River increased seasonally but remained below the normal range for the 3d consecutive month. In extreme southeastern Utah, the monthly mean discharge of 217 cfs in San Juan River near Bluff (drainage area, 23,000 square miles), was only 8 percent of median for April and in the below-normal range for the 9th time in the past 10 months.

In Virgin River basin, in extreme northwestern Arizona and the adjacent areas of Nevada and Utah, the monthly mean flow of Virgin River, as measured at Littlefield, Arizona, decreased contraseasonally, was only 25 percent of median, and remained in the below-normal range for the 6th consecutive month. The mean discharge of 66 cfs was only about 4 cfs greater than the minimum monthly mean in 48 years of record. Elsewhere in the State, streamflow was variable and was only about one-half of median except in San Pedro River at Charleston, in the extreme southeastern part of the State, where monthly mean discharge decreased seasonally but was slightly greater than the April median flow.

In northwestern Montana, flow in Marias River near Shelby (drainage area, 3,242 square miles) increased seasonally but remained below the normal range. The monthly mean discharge of 292 cfs was only 12 cfs greater than the minimum mean for April, and the daily mean of 141 cfs on April 2 was only 1 cfs greater than the minimum daily mean for the month, in 69 years of record. In western Montana, west of the Continental Divide, monthly mean flow in Clark Fork at St. Regis increased seasonally but was only about one-half of the April median flow, and remained below the normal range for the 4th consecutive month. East of the Divide, on Yellowstone River, monthly mean flows increased at Corwin Springs (156 percent of median) and at Billings (91 percent of median), and were in the normal range at each station.

In Oregon, monthly mean flows remained in the below-normal range at all index stations and generally were about one-half of median flow. In the east-central part of the State, flow in John Day River at Service Creek increased seasonally but was only 43 percent of median, and remained below the normal range for the 6th consecutive month. In southwestern Oregon, monthly mean flow in Umpqua River near Elkton decreased seasonally, was one-half of the April median, and was below the normal range also for the 6th consecutive month. In the northwest-coastal basin of Wilson River, monthly mean flow at the index station near Tillamook decreased sharply from the above-normal flow of March, and was in the below-normal range for the 6th time in the past 7 months.

In the lowland area of western Washington, monthly mean flow in Chehalis River near Grand Mound decreased seasonally, was about one-half of the April median, and was below the normal range for the 6th time in the past 7 months. In the lowland area of eastern Washington, monthly mean flow in Spokane River at Spokane increased seasonally but was only 37 percent of median, and in the below-normal range for the 6th consecutive month. (See graph on page 13.) Monthly mean flows also were below the normal range in Okanogan River near Tonasket (headwaters in British Columbia), and Klickitat River near Pitt (headwaters in the southern slopes of the Cascades). Monthend storage in 3 major reservoirs in the State was significantly below normal.



Monthly mean discharge of Spokane River at Spokane, Wash. (Drainage area, 4,290 sq mi; 11,100 sq km)

In southern British Columbia, high carryover flow from March, augmented by a sharp increase in flow near monthend, held monthly mean discharge in Fraser River at Hope in the above-normal range for the 4th consecutive month. In the adjacent basin of Skeena River, monthly mean flow increased seasonally at the index station at Usk, was more than 2 times the April median flow, and was in the above-normal range. In Alberta, monthly flows increased seasonally, were slightly greater than April median flows, and remained in the normal range.

In Nevada, monthly mean discharge in Humboldt River at Palisade increased seasonally but was only one-third of median, and remained in the below-normal range for the 3d consecutive month.

In southern Wyoming, monthly mean flow in North Platte River above Seminoe Reservoir, near Sinclair, increased seasonally, but was only two-thirds of median, and remained below the normal range for the 4th consecutive month.

In northeastern New Mexico, monthly mean discharge in Rayado Creek at Sauble Ranch, near Cimarron increased seasonally but remained below the normal range for the 4th consecutive month. In north-central New Mexico, monthly mean flow in Rio Grande below Taos Junction Bridge, near Taos, decreased contraseasonally and was in the below-normal range. Elsewhere in the State, flows increased but remained in the normal range.

Contents of the Colorado River Storage Project increased 67,230 acre-feet during the month.

Ground-water levels in eastern Washington rose but continued below average and below last year. The level in the key well in Spokane, although rising nearly 4 feet since the end of March, was nearly 6 feet below average, and at a new low for April for the second consecutive month. The level in the key well in western Washington rose less than a foot but was nearly 3 feet below average.

In Idaho, the level in the observation well in the sand and gravel aquifer in the Boise Valley rose a foot and was slightly above average at month's end, reflecting recharge from the beginning of the surface-water irrigation season. Levels in the key wells representative of the Snake River Plain aquifer declined and were below average in the eastern, south-central, and western parts, and declined but were 1 1/2 feet above average in the southwestern part near Eden. In the alluvial aquifer of the Rathdrum Prairie in northern Idaho, the level in the observation well declined nearly a foot and continued below average. In Montana, levels declined less than a foot and continued below average in the terrace gravel wells at Missoula and Hamilton; the level in the Hamilton well, after five consecutive new monthly lows, reached a new alltime low in 7 years of record. In southern California, levels in selected observation wells declined except in the well in the Lompoc area in Santa Ynez Valley, Santa Barbara County, where the level rose nearly a foot; levels in all the wells continued below average. In Nevada, the level in the artesian well in Steptoe Valley rose slightly, reaching a new high for April, and continued about 2 feet above average. In Paradise Valley, the level rose slightly but was 1 1/2 feet below average in the water-table observation well. The level in the artesian well at Truckee Meadows rose nearly 4 feet but continued below average and was at a new record low for April. In Utah, levels declined in most of the State; a new low for April was reached in the key well in the Holladay area. Levels continued below average in the Holladay and Flowell areas and above average in the Blanding and Logan areas. In Arizona, levels declined in four of the five index wells; new April lows were measured in four wells and new alltime lows were reached in the Elfrida and western Salt River Valley wells. In New Mexico, levels declined and continued below average in the water-table wells west of Hagerman and in the bolson deposits in the Mimbres Valley. Levels rose very slightly but continued below average in the Lovington well in southeastern New Mexico and in the well in the shallow alluvial aquifer in the southern part of the Roswell artesian basin. In the latter well, the level was once again at a new monthly low in 39 years of record. The artesian level declined 1 2/3 feet in the Berrendo-Smith well in the Roswell artesian basin, and was 3¾ feet below average.

ALASKA

Streamflow increased seasonally, as a result of above-normal temperatures and runoff from snowmelt, except on Kenai Peninsula, in south-coastal Alaska, where monthly mean flow in Kenai River at Cooper Landing

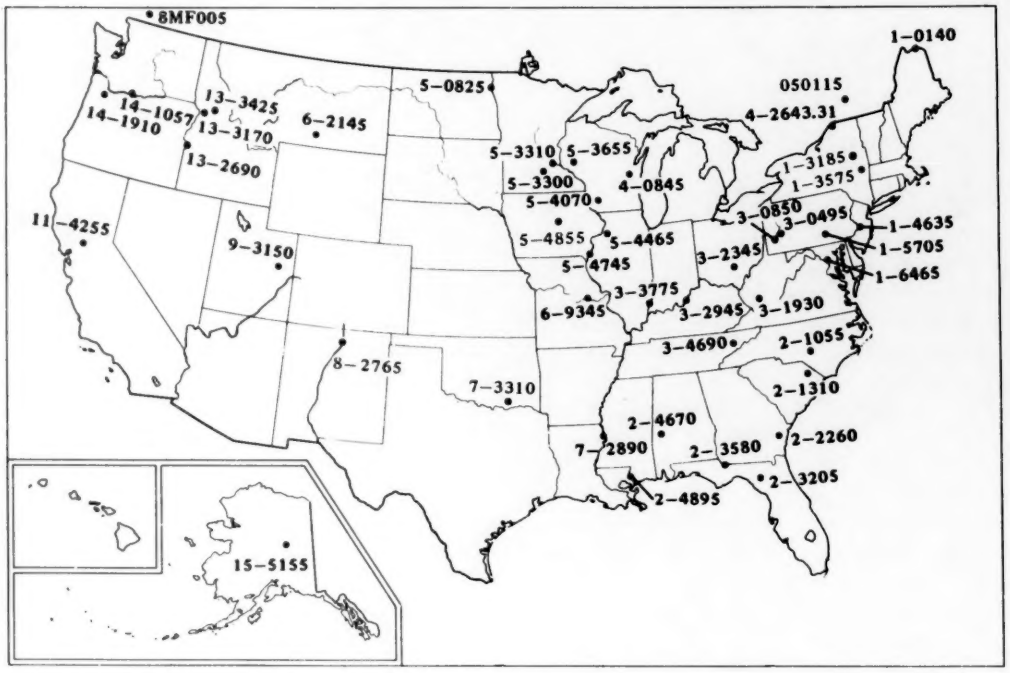
decreased contraseasonally but remained above the normal range because of high carryover flow from March. In the southeastern coastal area, monthly mean discharge in Gold Creek near Juneau increased seasonally and remained above the normal range for the 3d consecutive month. In south-central Alaska, flow at the index station, Little Susitna River near Palmer also increased seasonally, and was in the above-normal range for the 5th consecutive month. In the east-central part of the State, monthly mean flow in Tanana River at Nenana increased but remained in the normal range. In the adjacent tributary basin of Chena River, monthly mean discharge at Fairbanks increased slightly but was only about one-half of the April median flow, and remained in the below-normal range for the 11th consecutive month. Snowpack at high elevations in the State was reported to be much above normal.

The ground-water levels in the confined artesian system in the Anchorage area were stable in the lowland area near Cook Inlet, but continued to decline elsewhere with declines of about a foot common near the mountains. Water levels in the unconfined system were unchanged during the month.

HAWAII

Streamflow decreased contraseasonally at the index station on Waiakea Stream near Mountain View, island of Hawaii, but remained above the normal range for the 2d consecutive month as a result of high carryover flow from March when the monthly mean discharge was highest for period of record that began in 1930. Streamflow increased at the index stations on the islands of Maui and Oahu and was above the normal range at those sites for the first time since March 1973 and November 1974, respectively.

SELECTED STREAM-GAGING STATIONS ON LARGE RIVERS



Location of stream-gaging stations on large rivers listed in table on page 16.

METRIC EQUIVALENTS OF UNITS USED IN THE WATER RESOURCES REVIEW

(Round-number conversions, to nearest four significant figures)

1 foot = 0.3048 meter 1 mile = 1.609 kilometers
1 acre = 0.4047 hectare = 4,047 square meters
1 square mile (sq mi) = 259 hectares = 2.59 square kilometers (sq km)
1 acre-foot (ac-ft) = 1,233 cubic meters
1 million cubic feet (mcf) = 28,320 cubic meters
1 cubic foot per second (cfs) = 0.02832 cubic meters per second = 1.699 cubic meters per minute
1 second-foot-day (cfsd) = 2,447 cubic meters
1 million gallons (mg) = 3,785 cubic meters = 3.785 million liters
1 million gallons per day (mgd) = 694.4 gallons per minute (gpm) = 2.629 cubic meters per minute = 3,785 cubic meters per day

USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF APRIL 1977

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of Mar. 1977	End of Apr. 1977	End of Apr. 1976	Average for end of Apr.	Normal maximum
	Percent of normal maximum				
NORTHEAST REGION					
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	72	90	86	75	226,300 (a)
QUEBEC					
Allard (P)	46	93	94	123	280,600 ac-ft
Gouin (P)	53	60	64	72	6,954,000 ac-ft
MAINE					
Seven reservoir systems (MP)	49	90	97	65	178,500 mcf
NEW HAMPSHIRE					
First Connecticut Lake (P)	19	72	80	48	3,330 mcf
Lake Francis (FPR)	29	72	67	53	4,326 mcf
Lake Winnipesaukee (PR)	98	100	92	97	7,200 mcf
VERMONT					
Harriman (P)	55	61	92	77	5,060 mcf
Somerset (P)	56	90	79	74	2,500 mcf
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	86	95	85	88	3,394 mcf
NEW YORK					
Great Sacandaga Lake (FPR)	66	107	100	90	34,270 mcf
Indian Lake (FMP)	68	106	88	91	4,500 mcf
New York City reservoir system (MW)	99	100	99	.....	547,500 mg
NEW JERSEY					
Wanaque (M)	101	99	98	94	27,730 mg
PENNSYLVANIA					
Allegheny (FPR)	37	53	52	45	51,400 mcf
Pymatuning (FMR)	97	99	95	98	8,191 mcf
Raystown Lake (FR)	69	67	67	44	33,190 mcf
Lake Wallenpaupack (PR)	73	80	72	79	6,875 mcf
MARYLAND					
Baltimore municipal system (M)	92	95	100	94	85,340 mg
SOUTHEAST REGION					
NORTH CAROLINA					
Bridgewater (Lake James) (P)	86	92	89	93	12,580 mcf
Narrows (Badin Lake) (P)	91	95	93	102	5,617 mcf
High Rock Lake (P)	61	72	72	84	10,230 mcf
SOUTH CAROLINA					
Lake Murray (P)	92	92	90	81	70,300 mcf
Lakes Marion and Moultrie (P)	90	86	86	80	81,100 mcf
SOUTH CAROLINA--GEORGIA					
Clark Hill (FP)	84	80	77	76	75,360 mcf
GEORGIA					
Burton (PR)	95	99	93	92	104,000 ac-ft
Sinclair (MPR)	86	88	88	92	214,000 ac-ft
Lake Sidney Lanier (FMPR)	69	67	66	63	1,686,000 ac-ft
ALABAMA					
Lake Martin (P)	100	98	96	95	1,373,000 ac-ft
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	41	72	58	62	1,156,000 cfsd
Douglas Lake (FPR)	36	76	49	61	703,100 cfsd
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	60	88	75	78	510,300 cfsd
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	46	71	61	66	1,452,000 cfsd
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	55	85	73	77	745,200 cfsd
WESTERN GREAT LAKES REGION					
WISCONSIN					
Chippewa and Flambeau (PR)	58	84	98	69	15,900 mcf
Wisconsin River (21 reservoirs) (PR)	23	60	88	70	17,400 mcf
MINNESOTA					
Mississippi River headwater system (FMR)	17	22	26	31	1,640,000 ac-ft
MIDCONTINENT REGION					
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	79	79	88	.....	22,640,000 ac-ft
SOUTH DAKOTA					
Angostura (I)	68	81	74	85	127,600 ac-ft
Bell Fourche (I)	47	67	73	70	185,200 ac-ft
Lake Francis Case (FIP)	85	85	80	82	4,834,000 ac-ft
Lake Oahe (FIP)	86	86	84	.....	22,530,000 ac-ft

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of Mar. 1977	End of Apr. 1977	End of Apr. 1976	Average for end of Apr.	Normal maximum
	Percent of normal maximum				
MIDCONTINENT REGION--Continued					
SOUTH DAKOTA--Continued					
Lake Sharpe (FIP)	102	102	101	99	1,725,000 ac-ft
Lewis and Clarke Lake (FIP)	86	78	79	83	477,000 ac-ft
NEBRASKA					
Lake McConaughy (IP)	77	80	84	78	1,948,000 ac-ft
OKLAHOMA					
Eufaula (FPR)	83	91	106	116	2,378,000 ac-ft
Keystone (FPR)	74	81	91	116	661,000 ac-ft
Tenkiller Ferry (FPR)	88	100	123	97	628,200 ac-ft
Lake Altus (FIMR)	57	64	98	55	134,500 ac-ft
Lake O'The Cherokees (FPR)	77	83	95	92	1,492,000 ac-ft
OKLAHOMA--TEXAS					
Lake Texoma (FMPRW)	94	98	99	92	2,722,000 ac-ft
TEXAS					
Bridgeport (IMW)	94	100	86	48	386,400 ac-ft
Canyon (FMR)	95	100	99	69	385,600 ac-ft
International Amistad (FIMPW)	108	111	100	73	3,497,000 ac-ft
International Falcon (FIMPW)	100	100	86	66	2,667,000 ac-ft
Livingston (IMW)	100	100	100	75	1,788,000 ac-ft
Possum Kingdom (IMPRW)	88	98	91	97	569,400 ac-ft
Red Bluff (PI)	20	19	33	26	307,000 ac-ft
Toledo Bend (P)	96	99	92	86	4,472,000 ac-ft
Twin Buttes (FIM)	98	100	99	17	177,800 ac-ft
Lake Kemp (IMW)	78	82	77	87	268,000 ac-ft
Lake Meredith (FMW)	37	37	41	37	821,300 ac-ft
Lake Travis (FIMPRW)	99	100	95	79	1,144,000 ac-ft
THE WEST					
WASHINGTON					
Ross (PR)	9	12	35	25	1,052,000 ac-ft
Franklin D. Roosevelt Lake (IP)	28	30	7	45	5,232,000 ac-ft
Lake Chelan (PR)	31	44	53	40	676,100 ac-ft
Lake Cushman	49	53	75	89	359,500 ac-ft
Lake Merwin (P)	99	98	102	100	246,000 ac-ft
IDAHO					
Boise River (4 reservoirs) (FIP)	69	64	76	70	1,235,000 ac-ft
Coeur d'Alene Lake (P)	14	58	102	128	238,500 ac-ft
Pend Oreille Lake (FP)	39	49	51	57	1,561,000 ac-ft
IDAHO--WYOMING					
Upper Snake River (8 reservoirs) (MP)	78	75	54	74	4,401,000 ac-ft
WYOMING					
Boysen (FIP)	69	73	52	59	802,000 ac-ft
Buffalo Bill (IP)	53	57	43	61	421,300 ac-ft
Keyhole (F)	66	72	70	43	199,900 ac-ft
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	60	63	71	50	3,056,000 ac-ft
COLORADO					
John Martin (FIR)	6	0	0	15	364,400 ac-ft
Taylor Park (IR)	52	54	55	57	106,200 ac-ft
Colorado--Big Thompson project (I)	48	49	71	58	722,600 ac-ft
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Navajo, and Blue Mesa Reservoirs (IFPR)	71	71	79	.....	31,280,000 ac-ft
UTAH--IDAHO					
Bear Lake (IPR)	74	74	80	63	1,421,000 ac-ft
CALIFORNIA					
Folsom (FIP)	29	30	63	73	1,000,000 ac-ft
Hetch Hetchy (MP)	7	14	....	37	360,400 ac-ft
Isabella (FIR)	11	12	28	29	551,800 ac-ft
Pine Flat (FI)	29	33	54	59	1,014,000 ac-ft
Clair Engle Lake (Lewiston) (P)	44	42	80	90	2,438,000 ac-ft
Lake Almanor (P)	61	62	56	56	1,036,000 ac-ft
Lake Berryessa (FIMW)	62	59	80	90	1,600,000 ac-ft
Millerton Lake (FI)	45	43	76	68	503,200 ac-ft
Shasta Lake (FIPR)	33	29	70	92	4,377,000 ac-ft
CALIFORNIA--NEVADA					
Lake Tahoe (IPR)	19	18	63	61	744,600 ac-ft
NEVADA					
Rye Patch (I)	71	66	103	101	157,200 ac-ft
ARIZONA--NEVADA					
Lake Mead and Lake Mohave (FIMP)	83	80	78	64	27,970,000 ac-ft
ARIZONA					
San Carlos (IP)	1	0	8	18	1,073,000 ac-ft
Salt and Verde River system (IMPR)	45	45	67	50	2,073,000 ac-ft
NEW MEXICO					
Conchas (FIR)	23	24	23	76	352,600 ac-ft
Elephant Butte and Caballo (FIPR)	17	15	25	27	2,539,000 ac-ft

[a]Thousands of kilowatt-hours (the potential electric power that could be generated by the volume of water in storage).

FLOW OF LARGE RIVERS DURING APRIL 1977

Station number*	Stream and place of determination	Drainage area (square miles)	Mean annual discharge through September 1970 (cfs)	April 1977					
				Monthly discharge (cfs)	Percent of median monthly discharge, 1941–70	Change in discharge from previous month (percent)	Discharge near end of month		
							(cfs)	(mgd)	Date
1–0140	St. John River below Fish River at Fort Kent, Maine.	5,690	9,397	37,490	181	+882	50,000	32,000	30
1–3185	Hudson River at Hadley, N.Y	1,664	2,791	11,170	132	+75	11,000	7,100	30
1–3575	Mohawk River at Cohoes, N.Y	3,456	5,450	19,100	149	-8	.....	.....	.....
1–4635	Delaware River at Trenton, N.J	6,780	11,360	26,320	124	-30	14,600	9,440	25
1–5705	Susquehanna River at Harrisburg, Pa.	24,100	33,670	77,700	112	-32	68,400	44,200	30
1–6465	Potomac River near Washington, D.C.	11,560	[1] 10,640	21,330	123	-4	8,120	5,250	30
2–1055	Cape Fear River at William O. Huske Lock near Tarheel, N.C.	4,810	4,847	5,930	102	-42	2,080	1,340	30
2–1310	Pee Dee River at Peedee, S.C	8,830	9,098	19,400	150	-1	8,480	5,480	27
2–2260	Altamaha River at Doctortown, Ga.	13,600	13,380	30,510	127	-10	10,000	6,460	27
2–3205	Suwannee River at Branford, Fla	7,740	6,775	9,830	95	-37	6,650	4,300	29
2–3580	Apalachicola River at Chattahoochee, Fla.	17,200	21,690	37,090	116	-31	30,900	20,000	29
2–4670	Tombigbee River at Demopolis lock and dam near Coatopa, Ala.	15,400	21,700	77,620	214	-16	22,800	14,700	28
2–4895	Pearl River near Bogalusa, La	6,630	8,533	35,600	274	+7	33,200	21,500	30
3–0495	Allegheny River at Natrona, Pa	11,410	[1] 18,700	34,180	94	-38	34,000	22,000	26
3–0850	Monongahela River at Braddock, Pa.	7,337	[1] 11,950	18,200	100	-40	7,900	5,100	26
3–1930	Kanawha River at Kanawha Falls, W.Va.	8,367	12,370	25,000	155	+15	8,350	5,400	25
3–2345	Scioto River at Higby, Ohio	5,131	4,337	6,466	87	-18	2,700	1,700	27
3–2945	Ohio River at Louisville, Ky[2]	91,170	110,600	191,500	99	-21	82,800	53,500	26
3–3775	Wabash River at Mount Carmel, Ill.	28,600	26,310	37,630	81	-6	20,200	13,100	30
3–4690	French Broad River below Douglas Dam, Tenn.	4,543	[1] 6,528	17,390	183	+56	.....	.....	.....
4–0845	Fox River at Rapide Croche Dam, near Wrightstown, Wis.[2]	6,150	4,142	3,920	59	+97	.....	.....	.....
02MC002 (4–2643.31)	St. Lawrence River at Cornwall, Ontario–near Massena, N.Y.[3]	299,000	239,100	275,500	110	+11	283,000	182,900	30
050115	St. Maurice River at Grand Mere, Quebec.	16,300	24,900	56,800	137	+366	92,400	59,700	28
5–0825	Red River of the North at Grand Forks, N. Dak.	30,100	2,439	1,324	15	+168	800	520	30
5–3300	Minnesota River near Jordan, Minn	16,200	3,306	1,873	23	-40	1,410	910	27
5–3310	Mississippi River at St. Paul, Minn	36,800	[1] 10,230	7,120	26	0	7,750	5,010	26
5–3655	Chippewa River at Chippewa Falls, Wis.	5,600	5,062	6,138	63	+146	.....	.....	.....
5–4070	Wisconsin River at Muscoda, Wis	10,300	8,457	7,783	51	+26	.....	.....	.....
5–4465	Rock River near Joslin, Ill	9,520	5,288	4,720	56	+1	3,880	2,510	30
5–4745	Mississippi River at Keokuk, Iowa	119,000	61,210	49,226	42	+8	51,400	33,200	29
5–4855	Des Moines River below Raccoon River at Des Moines, Iowa.	9,879	3,796	552	11	-19	294	190	26
6–2145	Yellowstone River at Billings, Mont.	11,795	6,754	3,328	91	+39	6,000	3,900	30
6–9345	Missouri River at Hermann, Mo	528,200	78,480	51,050	53	+29	54,300	35,100	26
7–2890	Mississippi River at Vicksburg, Miss.[4]	1,144,500	552,700	819,400	84	+10	590,000	381,000	30
7–3310	Washita River near Durwood, Okla	7,202	1,379	940	87	+1	270	170	30
8–2765	Rio Grande below Taos Junction Bridge, near Taos, N. Mex.	9,730	732	305	46	-41	260	170	30
9–3150	Green River at Green River, Utah	40,600	6,369	2,908	43	+65	4,600	2,970	30
11–4255	Sacramento River at Verona, Calif	21,257	18,370	6,123	27	-8	6,750	4,360	28
13–2690	Snake River at Weiser, Idaho	69,200	17,670	8,694	41	-29	8,130	5,250	27
13–3170	Salmon River at White Bird, Idaho	13,550	11,060	6,783	64	+71	12,400	8,010	27
13–3425	Clearwater River at Spalding, Idaho	9,570	15,320	11,610	40	+122	23,800	15,400	26
14–1057	Columbia River at The Dalles, Oreg.[5]	237,000	194,000	98,460	44	+67	.....	.....	.....
14–1910	Willamette River at Salem, Oreg	7,280	23,370	17,890	62	-26	17,830	11,500	26–30
15–5155	Tanana River at Nenana, Alaska	25,600	24,040	8,083	119	+23	10,000	6,460	30
8MF005	Fraser River at Hope, British Columbia.	83,800	95,300	84,300	142	+109	220,000	142,000	30

[1] Adjusted.

[2] Records furnished by Corps of Engineers.

[3] Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.

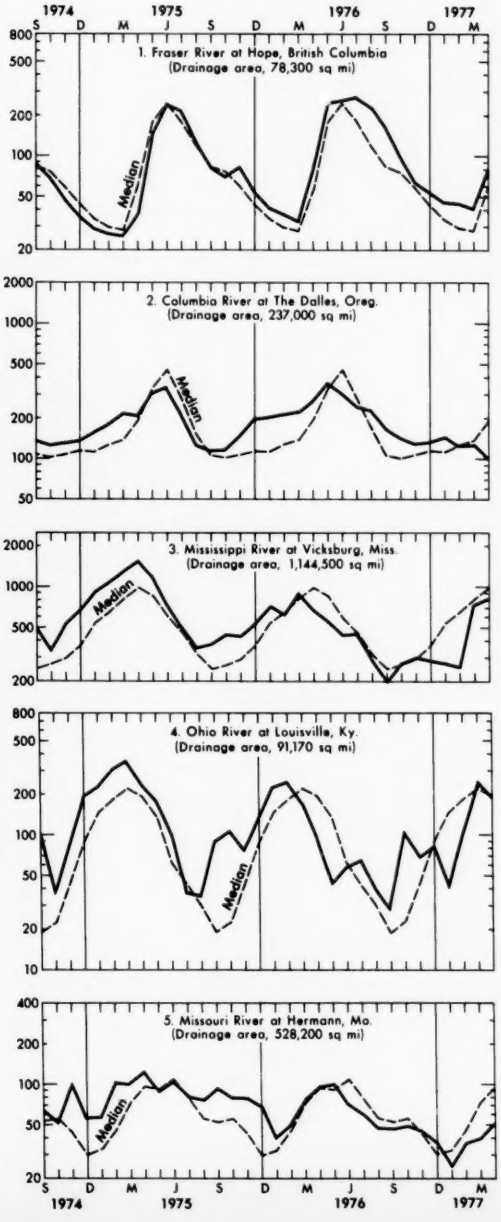
[4] Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.

[5] Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.

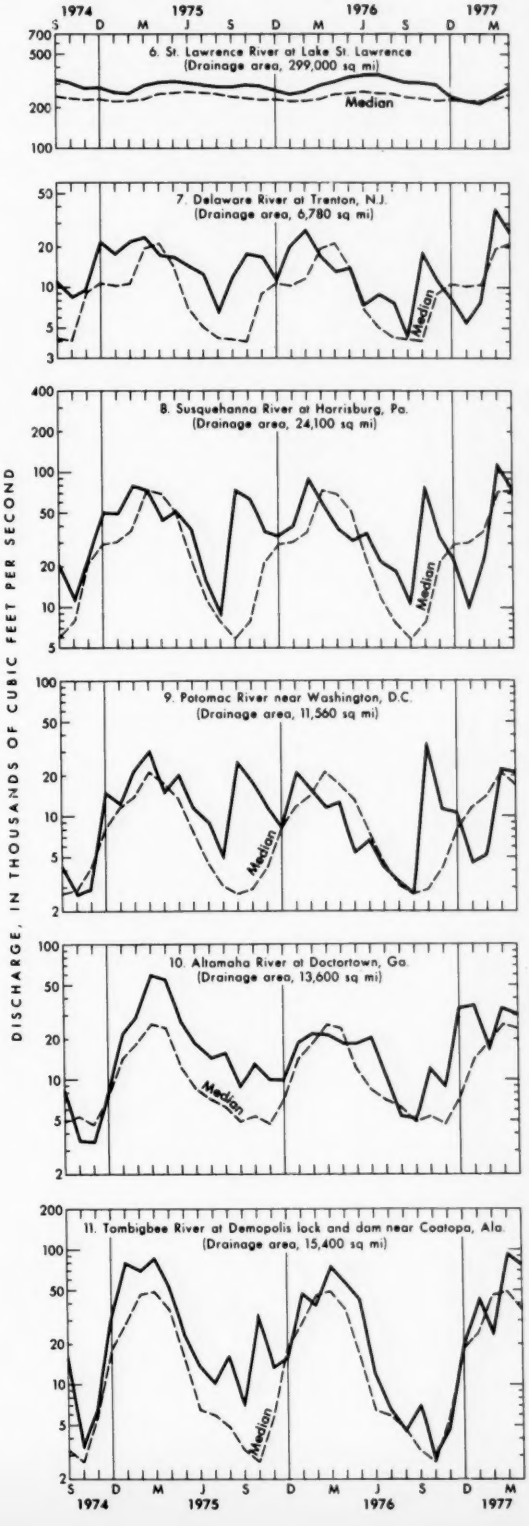
*The U.S. station numbers as listed in this table are in a shortened form previously in use, and used here for simplicity of tabular and map presentation. The full, correct number contains 8 digits and no punctuation marks. For example, the correct form for station number 1–3185 is 01318500.

HYDROGRAPHS OF SOME LARGE RIVERS, SEPTEMBER 1974 TO APRIL 1977

DISCHARGE, IN THOUSANDS OF CUBIC FEET PER SECOND



DISCHARGE, IN THOUSANDS OF CUBIC FEET PER SECOND



DISSOLVED SOLIDS AND WATER TEMPERATURES FOR APRIL AT DOWNSTREAM SITES ON SIX LARGE RIVERS

Station number	Station name	April data of following calendar years	Stream discharge during month	Dissolved-solids concentration during month[a]		Dissolved-solids discharge during month[a]			Water temperature during month[b]		
			Mean (cfs)	Minimum (mg/L)	Maximum (mg/L)	Mean	Minimum	Maximum	Mean, in °C	Minimum, in °C	Maximum, in °C
						(tons per day)					
	NORTHEAST										
01463500	Delaware River at Trenton, N.J.	1977*	26,400	80	103	4,070	2,230	6,810	12.5	7.5	16.5
	(Morrisville, Pa.)	1945–76 (Extreme yr)	21,750 [c21,180]	46 (1962)	113 (1964)	.....	1,240 (1966)	12,300 (1960)	.....	3.0	22.5
04264331	St. Lawrence River at Cornwall, Ontario, near	1977	276,000	164	165	122,000	118,000	126,000	3.5	2.0	4.5
		1976	305,500	166	168	138,000	124,000	146,000	4.5	2.0	6.5
	Massena, N.Y. (streamflow station formerly at Ogdensburg, N.Y.)	1966–76	270,500 [c250,500]	.....	.....	.....	.....	.....	3.5	0.5	7.5
	SOUTHEAST										
07289000	Mississippi River at Vicksburg, Miss	1977	819,400	155	188	370,000	299,000	457,000	17.0	14.5	19.5
		1976	673,500 [c981,200]	185	238	365,000	291,000	429,000	16.5	14.5	20.0
	WESTERN GREAT LAKES REGION										
03612500	Ohio River at lock and dam 53, near Grand Chain, Ill.	1977	473,500	140	195	.....	84,200	421,000	.....	14.5	18.5
	(25 miles west of Paducah, Ky.; streamflow station at Metropolis, Ill.)	1955–76 (Extreme yr)	453,600 [c450,800]	117 (1957)	282 (1969)	.....	22,400 (1976)	462,000 (1975)	.....	6.5	19.0
	MIDCONTINENT										
06934500	Missouri River at Hermann, Mo. (60 miles west of St. Louis, Mo.)	1977	51,400	194	389	46,600	41,400	54,800	16.0	9.5	20.0
		1976	97,100 [c95,600]	260	433	87,400	65,200	143,300	14.5	10.5	17.5
	WEST										
14128910	Columbia River at Warrendale, Oreg.	1977	104,300	121	127	34,400	22,300	43,500	9.0	7.0	11.5
		1976	266,700	85	108	68,700	46,100	90,500	9.5	8.0	10.0
	(30 miles east of Portland, Oreg.; streamflow station at The Dalles, Oreg.)	1968–76	232,100 [c190,600]	.....	.....	.....	.....	.....	.....	6.0	11.0

[a]Dissolved-solids concentrations when not analyzed directly, are calculated on basis of measurements of specific conductance.
[b]To convert °C to °F: [(1.8 X °C) + 32] = °F.
[c]Median of monthly values for 30-year reference period, water years 1941–70, for comparison with data for current month.
*Dissolved solids and water temperatures are for 8 days only.

DISSOLVED SOLIDS AND WATER TEMPERATURES FOR APRIL ON SIX LARGE RIVERS

The table at left shows dissolved-solids and temperature date for April at six stream-sampling sites that are part of the National Stream Quality Accounting Network (NASQAN). NASQAN, as established by the U.S. Department of the Interior, Geological Survey, is designed to describe the water quality of the Nation's streams and rivers on a systematic and continuing basis, so as to meet many of the information needs of those involved in national or regional water-quality planning and management.

"Dissolved solids," as described in several columns of the table, are minerals dissolved in water and usually consist predominantly of silica and ions of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulfate, chloride, and nitrate. These same minerals are among the most common components of the Earth's solid rocks and minerals, but gradually erode and at least partly dissolve as a part of natural weathering processes. Collectively these and other dissolved minerals constitute the dissolved-solids concentration expressed in milligrams per liter (mg/L) or the generally equivalent expression, parts per million (parts of dissolved matter in one million parts of water, by weight). Values of dissolved solids are convenient for comparing the quality of water from one time to another and from one place to another. Most drinking water contains between 50 and 500 mg/L of dissolved solids.

"Dissolved-solids discharge," expressed in tons per day, represents the total daily amount of dissolved minerals carried by the stream and is calculated by multiplying the dissolved-solids concentration (in mg/L) by the stream discharge (in cfs; times a unit conversion factor of .0027). Even though dissolved-solids *concentrations* are generally higher during periods of low streamflow than of high streamflow, the highest dissolved-solids *discharges* occur during periods of high streamflow because the total quantities of water, and therefore total load of dissolved minerals, are so much greater than at times of low flow.

WATER RESOURCES REVIEW

APRIL 1977

Based on reports from the Canadian and U.S. field offices; completed May 12, 1977

TECHNICAL STAFF

Allen Sinnott, Editor
Carroll W. Saboe, Associate Editor
Herman D. Brice
Thomas H. Woodard
Ruth M. Kosco
John C. Kammerer

COPY PREPARATION

Lois C. Fleshmon
Sharon L. Peterson
Donna L. Radcliffe
Stephanie F. Michie

GRAPHICS

Frances B. Davison
Carolyn L. Moss
Leslie J. Robinson
Joan M. Smith

EXPLANATION OF DATA

Cover map shows generalized pattern of streamflow for April based on 20 index stream-gaging stations in Canada and 130 index stations in the United States. Alaska and Hawaii inset maps show streamflow only at the index gaging stations which are located near the points shown by the arrows.

Streamflow for April 1977 is compared with flow for April in the 30-year reference period 1941–70. Streamflow is considered to be *below the normal range* if it is within the range of the low flows that have occurred 25 percent of the time (below the lower quartile) during the reference period. Flow for April is considered to be *above the normal range* if it is within the range of the high flows that have occurred 25 percent of the time (above the upper quartile).

Flow higher than the lower quartile but lower than the upper quartile is described as being *within the normal range.* In the Water Resources Review the median is obtained by ranking the 30 flows of the reference period in their order of magnitude; the highest flow is number 1, the lowest flow is number 30, and the average of the 15th and 16th highest flows is the median.

The normal is an average (but not an arithmetic average) or middle value; half of the time you would expect the April flows to be below the median and half of the time to be above the median. Shorter reference periods are used for the Alaska index stations because of the limited records available.

Statements about *ground-water levels* refer to conditions near the end of April. Water level in each key observation well is compared with average level for the end of April determined from the entire past record for that well or from a 20-year reference period, 1951–70. *Changes in ground-water levels,* unless described otherwise, are from the end of March to the end of April.

The Water Resources Review is published monthly. Special-purpose and summary issues are also published. Issues of the Review are free on application to the Water Resources Review, U.S. Geological Survey, Reston, Virginia 22092.

SEDIMENT CHARACTERISTICS OF STREAMS IN THE EASTERN PIEDMONT AND WESTERN COASTAL PLAIN REGIONS OF NORTH CAROLINA

The abstract and map below are from the report, *Sediment characteristics of streams in the eastern Piedmont and western Coastal Plain regions of North Carolina,* by Clyde E. Simmons: U.S. Geological Survey Water-Supply Paper 1798-0, 32 pages, 1976. This report may be purchased for $1.40 from Branch of Distribution, U.S. Geological Survey, 1200 S. Eads St., Arlington, VA 22202 (check or money order payable to U.S. Geological Survey); or from Superintendent of Documents, Government Printing Office, Washington, D.C. 20402 (payable to Superintendent of Documents).

ABSTRACT

The sediment-transport characteristics of streams were determined in a 15,500-square-kilometer (6,000-square-mile) area of the Coastal Plain and Piedmont regions of eastern North Carolina during 1969–73. The study covered all or parts of 21 counties and included data for 28 sediment-sampling stations in parts of 4 major river basins—the Roanoke, Pamlico, Neuse, and Cape Fear. Annual suspended-sediment yields ranged from 117 to 4.2 tonnes per square kilometer (333 to 13 tons per square mile). Streams in the Piedmont region have the highest yields. Suspended-sediment yield decreases in an eastward direction from the Piedmont to the Coastal Plain region. (See figure 1.)

Sediment characteristics are directly affected by topography, storm runoff, geology, land use, and man-made detention structures. At one sampling station in the 1973 water year 44 percent of the suspended sediment tonnage was transported during 34 days of high flow. In the Piedmont region, sediment yields vary indirectly with the percentage of forest cover in the basin, but there appears to be no definite relationship between forest cover and sediment yield in the Coastal Plain region. Large lakes act as sediment-detention reservoirs. Average annual sediment yields ranged from 34 to 117 tonnes per square kilometer (98 to 333 tons per square mile) for 3 headwater streams which flow into Hyco Lake in Person County; however, the yield for the station less than 3.2 kilometers (2 miles) downstream from Hyco Dam was about 4.2 tonnes per square kilometer (12 tons per square mile).

Most suspended sediment during floods in Piedmont streams ranges in size from sand to silt, whereas the suspended material in flooding streams in the Coastal Plain is generally clay size.

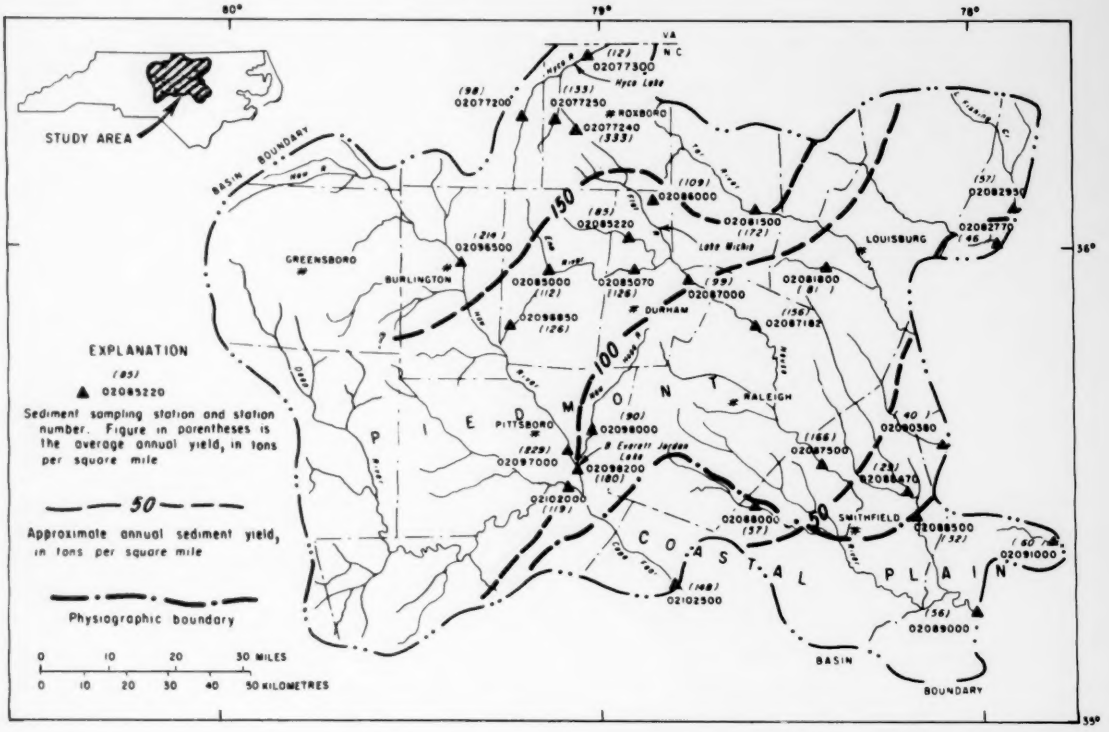


Figure 1.—Average annual sediment yields, 1969–73.